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DESIGN FOR A COUNTRY CHURCH AND RECTORY

BY

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THESIS

For the Degree of

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IN ARCHITECTURAL DECORATION

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

ARSELIA BESSIE MARTIN

ENTITLED DESIGN FOR A COUNTRY CHURCH AND RECTORY

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Bachelor of Science in Architectural Decoration

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Instructor in Charge

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A COUNTRY CHURCH AND RECTORY

-:-

By the term "country" is meant a rural community, a small village, or a thinly settled suburb of a city, where the grounds for the church will not necessarily be restricted and where simplicity in design, set off by natural landscape features, may be indulged in.

The church will be for the Episcopal service, which is possibly more in sympathy with architectural feeling than are the services of the evangelical denominations.

It is assumed that there is a moderate amount of wealth and refinement in the parish. There are about two hundred or two hundred and fifty communicants, which means that it would be necessary to provide for a congregation of nearly three hundred and fifty.

The location is assumed to be in the middle west.

In choosing this problem there have been several considerations. Few architects ever have a chance to design a cathedral but country churches are the common lot of most of us. This is probably the reason why their design is overlooked as a real and serious problem deserving more than the passing notice of the architect. The matters of style, proportion, materials, exterior and interior treatment, etc., require special study. In a recent editorial in Christian Art Mr. R. A. Cram says "that the problem of the little country church is one of the most insistent at the present day and its importance is quite commensurate".

Again, in his book on Church Building Mr.Cram says: "It can not be too constantly held in mind, it cannot be too steadily reiterated, that a village church is in its nature a matter of paramount importance, not only from an architectural standpoint, but from that of civilization. It is not the Sunday club of a certain organization: it is ,or should be, the concentration of the life of the people, the greatest influence that is brought to bear upon them. The village church should be the spiritual, ethical, and artistic inspiration of the people. If it succeeds in all of these directions, it is triumphant."

The possibilities for interior treatment are very wide. For inspiration there are the magnificently colored interiors of the Byzantine period, the brilliant color treatment of the interiors of country churches of gothic style in England, also some of the very recent attempts in ecclesiastical decorations in England and Germany. However, the color treatment of church interiors has not been carried on in this country with general success so that there seems to be little danger of repeating much that has already been done here.

It is with the hope that some practical value may be obtained that this design of a country church and rectory is here undertaken.

For a church designed for the Episcopal communion there is but one model that can be logically and consistently followed and that is the style that was developed in England between the middle of the twelfth and the middle of the sixteenth centuries, the so called Gothic, or what Mr.Cram prefers to call Christian. The historical and racial associations of this style are invaluable

and not to be found in any other style. The architecture preceding the Gothic,- the Byzantine,- was but incipient Christian: it was crude and undeveloped compared with that which followed. The origin of the the Classic and Renaissance styles of architecture are distinctly pagan, and beautiful as they may be, they have no deeply rooted associations with Christianity and are, therefore, lacking in power to inspire proper religious emotions. After studying the modern German ecclesiastical style we feel that it should be avoided because of its lack of association with any historical religious expression.

In making use of the English Gothic as the style for this particular problem there has been no intention of following historic precedent, especially in detail, too closely. But rather it has been the aim to incorporate into the design the true Gothic spirit which is freedom of expression rather than adherence to certain set rules of form and detail. Both the mediæval and modern churches, especially the country churches of England have been studied with the purpose of determining as far as possible the application of their best features to the problem in hand.

Some of the features of decoration, that is, the colored inlays of which we will speak later, are adapted largely from suggestions offered by the Byzantine style.

The requirements of the plan for a church of this kind are largely determined for us by centuries of precedent. Therefore any striking innovations in the plan are inappropriate. The plan is not that of an auditorium as in the case of most of the evangelical churches. It is true that the preaching service is of growing importance and that all members of the congregation should be able

to see and hear the preacher; but the preeminent purpose of the church is a place of worship,- a "place which stands for God's presence in the world," as Rev. Herman Page puts it in his paper on the Test of Church Architecture, published in The Brickbuilder, vol. 14. It is self-evident that any form of plan that reminds one of a lecture room or a theatre is not likely to inspire any but worldly emotions.

The cruciform plan, beautiful in its symbolism, is, however, unnecessary and even undesirable for a small church; it requires bigness to produce the the desired effect with the cruciform plan. The principal thing is to keep the nave long, high and narrow, not only for acoustics but for emotional and artistic effects as well. Aisles are necessary for interesting light and shade as well as for practical purposes and they are also symbolic. If the aisles of a small church are very wide they will be partly filled with seats; or they may be narrow and be used merely as ambulatories. In the present case the latter style has been adopted, narrow aisles being carried in the buttresses.

Except in the very smallest churches a morning chapel should be provided, and the best place for it is near an entrance where it will be easy of access. It is well to plan it so that the seats may be used when the service is at the high altar. Other chapels may be added almost anywhere,- the more there are of them the finer the interior effect of the church is sure to be. These chapels being smaller in scale than the nave offer opportunities for enrichment with delicate detail. The chapel chancel should be small and bear the proper relation to the main chancel. The altar should not be elevated by many steps as the minister may not

have any attendants at that service.

The historic position for the baptistery when it was not a separate building was at the west entrance to the church, signifying that it was the place of the beginning of the Christian life. The symbolism of the baptistery is worthy of recognition, and it is of sufficient dignity to be permitted a place in the architectural scheme of the church, such as the center of the west end of the nave, an entire bay of an aisle, or a bay of a tower. It is frequently desirable to place the baptistery near the front of the church, convenient to the sacristies, and this is quite permissible, but the line is strongly drawn against placing it within the chancel. The font is one of the features of the church where a great deal of elaboration is permitted. A cover should always be provided for the font in order to prevent thoughtlessly using it as a place for flowers and decorations quite inappropriate. When the cover is quite heavy it is a good plan to suspend it from the ceiling with pulleys so that it may be raised and lowered with ease.

The chancel is located at the east end of the nave and contains the choir and sanctuary. For best effect it also should be long and narrow, its length twice its width if possible. It is well to have the chancel about three-fifths the length of the nave. There should be several steps, usually three, leading to the choir and each row of choir seats should be elevated at least one step above the row in front. The clergy stalls may be arranged back of the choir seats,- sometimes they are returned across the front when there is a rood screen, the clergy sitting with their backs to the congregation and the facing the altar. The choir seats are arranged on either side of the chancel and a passage at least ten

feet wide leading to the sanctuary should be left through the choir. The sanctuary should be raised above the level of the choir by one or two steps. The altar is usually raised at least three steps. The principal interest of the church converges toward the high altar and it is here that the greatest amount of enrichment is desirable. No matter how plain the nave of the church may be the altar may be as elaborate as the funds will permit. This is a matter of architecture as well as doctrine. The altar itself should be of stone or marble significant of its imperishable nature. The reredos back of the altar may be of either stone or wood and may be enriched by paintings, carvings, colored and gilded sometimes, or by mosaics. If the church is very lofty or if there is no east window the reredos may be very lofty, sometimes entirely filling the east wall. Whether the reredos is high or low it should be kept architectural in character, not "confectionery".

In any but a very large and lofty church it is better that the chancel be lighted at the sides as an east window is apt to be annoying to the vision of the worshipper as well as spoiling the effect of the altar.

The chancel arch separating the nave from the chancel may well be dispensed with and the lines of the nave carried through to the east wall. Any diminution in the height of the church is unfortunate. A rood screen although allowable in a small church is unnecessary and frequently objectionable as cutting off the altar from view. A very long and high church, however, sometimes requires a rood screen for the best architectural effect. The rood beam meets the modern requirements and preserves the symbolic significance.

Besides the altar and reredos the sanctuary contains the bishop's sedilia on the north or gospel side, and the preist's sedilia, divided in three , on the south or epistle side. The credence located on the south or east wall holds the altar vessels, candles, etc.

Two sacristies, one for the clergy and the other for the choir, are imperative. Lockers for the choir vestments, if there is a vested choir, should be provided. In the clergy sacristy there should be wardrobes for cassocks and surplices, drawers and cases for other vestments, and a "prie-Dieu" are needed. The sacristy is not intended to be used as a study. In most churches there should be an altar sacristy where there the things belonging to the altar can be properly attended to. This room may be used for the altar guild and the acolytes.

Other rooms, as for vestry meetings, women's guild meetings, etc., are sometimes needed, but these rooms do not partake of the solemnity of the sacristies and **are not**, therefore, so much an integral part of the church. They may be located in a separate wing or may form the connecting link between the church and the house.

There should be a close connection between the rector's dwelling and the church, but it is not desirable that they should be crowded together too closely. Some transition with a covered passageway is a good arrangement. The rectory should bear the proper relation to the church: it should be in the same style and usually of the same material: it should neither be mean or overelaborate, but should afford ample accomodations for the family and for the guests they must naturally entertain. A reception of

room of a public nature should be placed near the front entrance, a large living room and dining room should be closely related to each other but separated from the reception room. The study should be isolated and free from noises and other disturbances as its nature is more private than the other rooms on the first floor. The kitchen may be in a separate wing, connected with the dining room only by the butler's pantry. It should have light and air from at least two sides and from three if possible. A service yard walled in encloses the unsightly things that usually disfigure the back yard. The sleeping rooms for the family and guests, bath rooms, etc., are located on the second floor.

The grounds surrounding the church should be ample enough for a proper setting. It is not allowable that the church crowded against the street as is so often necessary in a city. A drive leading to the door or a porte-cochere is desirable. For the rectory there should be plenty of open lawn and shady trees. Then there should be some sort of an enclosed garden, preferably away from the street side, where the family may enjoy some seclusion.

It has been assumed that the parish is only moderately wealthy and perhaps not more than fifty thousand dollars is at the disposal of the building committee. However little a church is to cost it is quite inconsistent with a truly religious spirit to use shoddy and perishable materials. Stone is generally considered the ideal material for church architecture, both for exterior and interior use; but in many parts of the middle west, where it is assumed that this parish is located, it is difficult to obtain a perfectly satisfactory building stone at moderate cost. Brick is an easily obtained and perfectly legitimate material and has been

used to splendid advantage in low cost modern churches in Ireland; but for interior treatment it does not offer an especially interesting problem. Concrete is suggested as the material to be used in this and has been accepted after due consideration. It is selected with the intention of using it as concrete, not merely as a core to be veneered or as a bald imitation of stone. The church will be monolithic, the cloisters and rectory of hollow tile covered with a rough coat of stucco.

We are aware that concrete does not meet the approval of architects in general at the present time. Nevertheless, it is a material that is rapidly coming into prominence and demanding the attention of architects as having marked aesthetic possibilities, as was evidenced by the discussion at the meeting of the American Institute of Architects recently. The American Architect took up the subject and in the issue of May 4, 1907, published the opinions of numerous prominent architects from whom we quote.

"The use of concrete has evidently come to stay. It should not be forced to compete with other materials but it has a definite use." Mr. Donn Barber.

"If used with discrimination and judgment on logical lines of construction, with the introduction of other materials for decorative purposes,-- if color is properly used and distributed in the ornamentation, we believe it to be susceptible of application and development on artistic lines. . . . We feel, on the whole, that this material is only adapted to utilitarian or commercial buildings and in picturesque schemes, but in no way fit for the more serious, monumental or classic buildings, whether of a public or private nature". This from Messrs. Carrere and Hastings,

pioneer designers in concrete, is a little discouraging.

Russell Sturgis says: "I fear that any attempt to build in monolithic or solid masses would be ruinous to the external effects, and equally so to the larger and more interesting interior design. In architectural work much charm results from slightly irregular surfaces of the different units of the wall. Slight differences in color are invaluable". Then he adds in a more encouraging note: "If some one would build a monolithic church, having first considered very carefully the effect of brilliant color and the pattern with which he proposes to decorate his church, then, indeed, we should rejoice to follow his experiment!"

The opinion of Mr. Louis Sullivan is as follows: "I have scarcely a doubt that reinforced concrete will lend itself to effective exterior treatment, especially, perhaps, in the way of inlays or mosaic effects, provided the scheme of the building is designed in the beginning for such results. If designed in accordance with its essential nature I have no doubt that extremely interesting and varied results might be obtained".

Mr. Evarts Tracy, in his report before the American Institute of Architects, urges the idiomatic expression of concrete. "Concrete", he says, "is here as a reality and demands a hearing from architects as well as engineers. . . . When used as a bald imitation of something else, notably blocks in imitation of stone, it is nothing less than immoral, and any architect of education and feeling who will consent to use it in such form is, I believe, without an immortal soul".

Mr. I. K. Pond, in his report before the Institute maintains that "the possibilities, even aesthetic possibilities, within the

range of reinforced concrete construction can hardly be estimated. Every advance in the science of its manufacture and use will signal an advance along the lines of artistic application. The architecture of a reinforced plastic material may, and logically will, express itself throughout the entire structure to the remotest core. the unity, the truth, the harmony of the whole may in every part be manifested. Aesthetically there would seem to be unlimited possibilities in reinforced concrete. The saving grace of ornamental terra cotta and tile, beautiful in color and texture, also sculptured stone, used merely to embellish not conceal, may be needed in the early days to save the design from a too brutal conception of the forms they deem the material must necessarily take".

Numerous other architects suggest the use of color inlays and terra cotta as the most feasible method of embellishing, not covering up or hiding in any way, reinforced concrete. The success of this method is to be seen in the new Marlborough-Blenheim hotel; also in the grill room of the Racquet Club in Philadelphia. Mr. Henry C. Mercer, who designed the ornamentation for the latter, has made repeated experiments and is prepared to speak authoritatively on the matter. In his recent article in The Cement Age he sums up the results of his experiments as follows:-

1st. Amount of decoration. Five to ten per cent of the whole area is sufficient to give the desired result.

2nd. Form of decoration. Mosaic panels, both pictorial and geometrical, are employed. Designs are suggestions from Egyptian, Byzantine, Moorish, etc., motifs. Structural lines are emphasized by mere lines of color. Burnt clay is used for the color and is both flat and modeled. Wide joints of cement form a part of the

pattern. Panels are sunk, raised, or flush with the concrete surfaces.

3rd. Kind of color. The natural burnt clay colors harmonize best with the gray background of the concrete, but brilliant yellows, greens, reds, and blues are needed to give sparkle. Both the glazed and unglazed pieces are used for contrasting effects.

4th. Insertion of the mosaics. The design may be set in sections or as a whole at the potteries. Or the ordinary geometrical patterns can be set into grooves left in the forms, or a groove for a narrow band may be cut. Or the mosaics may be laid face down on the moulds and cast with the concrete.

"Experiment has shown where a real wall or a real column has escaped the plasterer and where those imperishable colors were imbedded into the very life of the building, weather and time-proof as the structure itself, the needed life and glow has been added to the rough-hewn structure".

Mr. Mercer goes farther than may be expected in preferring the board marks of the moulds to be left on the concrete. The board marks are not particularly interesting and when they may be easily removed it seems an affectation not to do so. Of course a smooth or "slick" surface is quite undesirable for both practical and aesthetic reasons. A roughened surface is needed to conceal any hair cracks that are pretty apt to occur but which do not affect the strength of the wall. A thin skin is sure to form on the surface of the concrete when it is properly mixed and rammed, and it is this gray skin of cement that makes the concrete seem so ugly. There are two methods of removing it and bringing out the sparkle of the aggregates. One is to remove the forms early and scrub the surface

with water while the concrete is still "green". This is a very easy method and has been successfully done many times, but there is always some danger in removing the forms too early. The other method is to leave the forms up until the concrete is properly set and then at any subsequent time the surface is scrubbed in the same manner using some diluted acid, hydrochloric or muriatic acid is generally used. An alkaline wash is then necessary to remove the acid. This can be done by unskilled labor and a very low cost per square yard. It is safer than the first method as there is no risk taken in removing the forms too early. However, when acid is used lime stone aggregates are out of the question, but sand stone or granite may be substituted. Besides removing the cement skin, scrubbing also destroys the board marks and minimizes any slight surface defects such as pits. The acid treatment has been used very successfully in the South Park system in Chicago.

Efflorescence is another defect frequently found in concrete. It is the result of hair cracks or joints which admit moisture. The hair cracks are largely done away with by the roughened surface treatment. The joints are due to the method of laying the concrete, that is, in allowing layers to stand some hours before adding the next layer. This may be properly corrected by the proper supervision of the work.

The reasons for selecting concrete reinforced with steel as the material to be employed may be summarized as follows:-

- 1st. Its essential character is permanence and endurance so necessary in ecclesiastical architecture.

- 2nd. It is especially suited to a style whose ideal is to express both lightness and strength of construction.

3rd. It is possible to use the same material throughout the entire shell, making it a magnificent monolith. The construction is rational and appeals especially to the Gothicismist. The result is a building that will endure for countless ages, a monument to the religious zeal of the builders, and, incidentally, to the skill of the architect.

4th. It solves the problem of roofing, at least theoretically. The usual method of roofing a small church is by means of wood trusses unconcealed. The country churches of England furnish many examples of open timber roofs. Undoubtedly wood was used in preference to the stone vaulting because of its greater ease of handling and because stone could not be obtained in many localities. Stone was reserved for the larger churches. Vaulted roofs were the logical development of Gothic architecture, and although not necessary to the style are very valuable for fine effects. A lofty vaulted church is the very pinnacle of religious architecture. Stone vaulting is seldom indulged in at the present time because of the great expense of it and the difficulty of construction. Vaults of lath and plaster are not to be considered by the conscientious architect, and they offer a sham not to be tolerated by the religious devotee, also they are at variance with the spirit of Gothic architecture which demands sincerity of construction and honest use of honest materials.

Reinforced concrete vaulting may be made so very light that the thrusts of the arches are considerably reduced. It is true that concrete vaulting is largely a matter of theory rather than actual practise with us yet, but it is not to be doubted that it may become more generally used in time and especially when its aesthetic

possibilities are comprehended. A brick church recently built in Handberg, Belgium, and described in Eaton und Tisen, 1905, has reinforced concrete Gothic vaulting. This material was selected because of the failure of some brick arches in the neighborhood of the church. According to the practice common on the continent, the cross ridge was curved, the crowns of the intersecting arches being at different levels. This gives the cross vaults warped surfaces which makes the building of forms for them especially difficult, but it was successfully done. We are sorry to note, however, that there was no attempt made to treat the concrete vaults in any characteristic manner. They were simply plastered and regulation mouldings were run in gypsum plaster.

5th. The materials for concrete are easily obtained almost anywhere. For work that will not be covered up it is necessary to have a pleasantly colored aggregate, buff sand stone or granite being very desirable. This is easily imported. Sand and cement of excellent quality is usually found close at hand.

While it is true that the services of an expert engineer would be required for such a building as this, yet a great deal of the workmen employed may be unskilled.

We do not mean to hold out the idea that a reinforced concrete building is cheaper than one of stone or brick at the present time. Some architects maintain that it is so, while others dispute it, but it seems to be the general opinion most builders that reinforced concrete is fast becoming a most practical and desirable material. In a theoretical problem we deem it permissible to look beyond into the future.

In searching for examples of concrete construction we turn

to the very earliest builders but find that they used it merely structurally and not as a material worthy of adornment. The ancient Assyrians covered it completely with slabs of alabaster or colored tiles. The Greeks built their temples frequently of a very soft stone and then covered them with a marble dust cement stucco. This served as a background for a very brilliant polychromy, and was the nearest treatment approaching our problem to be found in the ancient world. We search in vain for any more suggestions until the Renaissance period in Italy. Stucco architecture was revived then and made very interesting with color, low relief ornament, sgraffitto decorations, etc. But we wish to avoid all suggestions of the classic style. The mission style of Southern California offers special suggestions in the handling of the masses of the concrete, broad unbroken surfaces giving a very fine effect. They do not give us many ideas as to embellishment, however. We find the best hints for color treatment in the modern German work. While the lines of the last named style are generally ugly, the Germans have attained to a high degree of skill in the handling of color in exterior work.

The treatment decided upon for this problem is that of flat broad masses for dignified effects. The buttresses are kept wide and shallow rather than thin and strongly projecting as in stone Gothic. Deep buttresses are unnecessary as the thrust of the light arches is not so great as to demand them. Mouldings are omitted as much as possible as being ineffective in this material. Instead of the rich carvings which adorn the churches of the middle ages, color inlays are used. These are sunk, raised and flush. The colors are those of the Byzantine period mostly, - brilliant reds,

blues and greens together with much gold; but intermediate colors are introduced, especially in the lower surfaces, so that the entire spectrum is employed. The soft warm gray background of the concrete, wide mortar joints between the colors, as well as the gold tend to combine even the most brilliant colors and produce a harmonious effect. Most of the exterior decorations are such as can be cast with the concrete. The inscriptions on the morning chapel frieze and under the windows of the north aisle will need to be made up in blocks and set into place. The exterior surfaces will be scrubbed with acid to bring out the color of the aggregates. The traceries will be of a fine quality of cement stone.

The same treatment will be carried throughout the interior, except that smaller aggregates will be used as it is not so desirable to have the interior quite so rugged. No attempt will be made to cover up the concrete. The surface will be scrubbed with acid in the same manner as the exterior. Mouldings of concrete, other than chamfers and splays, are avoided. There are some narrow mouldings in colored terra cotta under the windows. The groin lines will be left unmoulded and with ragged edges, no attempt being made to finish them up perfectly true and mechanical. It is believed that the waviness of the line will be more in keeping with the general character of the treatment. The colored inlays are used to emphasize the structural lines of the vaults and arches, and may be used more lavishly in the interior than on the exterior. The same colors as used on the exterior will be employed. No attempt is made to vie with the colors of the stained glass windows which should form the chief color note of the interior.

In the design of the stained glass there has been an

attempt made to recognize the function of window decoration as a part of the wall . Therefore effects of canvas paintings have been avoided and the limitations of the material recognized and turned to account in mosaic effects. The designs are composed of figures of saints and angels, and symbolic devices introduced in order to express a purely religious character. Bold colors of pot metal glass are used to give an effect of richness not obtainable in the uncertain and often unpleasant colors of the opalescent glass. much white glass has been used for the background in order to admit plenty of light. The lead lines have been utilized as much as possible as part of the designs and not suppressed or entirely ignored. The windows designed and executed by Mr.B.E.Goodhue have been particularly studied as embodying the best principles of American stained glass design.

The floor of the nave and aisles will have both plain and decorated tiles inlaid in the cement with very wide joints between so that the effect will be that of a cement floor decorated with tiles rather than a tile floor. For the chancel floor and steps marble mosaics are introduced, the sanctuary floor being almost entirely of marble as it is here that materials of real intrinsic value are demanded.

The altar itself will be of white marble carved. The font will probably be of this same material as great richness is also allowable here.

The reredos, rood beam, choir and clergy stalls, etc., as well as pews, will be of fumed oak, carved in such a manner as occasion demands. The rood beam, rood and reredos, also the paneling and screens against the chancel walls, will have the carving

decorated with colors and gilding to bring out the richness of the design to best advantage. This in accordance with numerous Gothic remains in England where a considerable amount of color is used on the woodwork and walls.

The lamps will be of iron and colored glass and placed so as not to interfere with perspective effects and at the same time serve the congregation. There will not be much attempt made at general illumination as the effect of vastness of the interior is best preserved by keeping the upper parts dimly lighted.

The problem has been resolved into a combination of the practical and ideal. It is not intended to be a complete solution but merely a study that may prove beneficial.

Information and ideas have been obtained from the following sources:-

Church Building	Ralph Adams Cram
The Gothic Quest.	" " "
Country Churches in England..."	" "
Christian Art, volumes 1 & 2.	
A Manual of Church Decoration and Symbolism	
Open Timber Roofs of the Middle Ages . .	Brandon
The Architectural Review, January, 1908.	
The Brickbuilder, volume 14.	
The American Architect, May 4, 1907.	
The Cement Age, January, 1908.	
Beton und Eisen, volume 4.	
Architektonische Rundschau	
Der Architekt	Recent volumes.

Bulletin No.10, published by the American Cement Manufacturers Association.

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